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(71) Applicant *(for all designated States except US)*: KONINKLIJKE EMBALLAGE INDUSTRIE VAN LEER N.V. [NL/NL]; P.O. Box 25, NL-1180 AA Amstelveen (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: KEIMPEMA, Gerrit, Jan [NL/NL]; Schermerhornlanen 21, NL-3445 ET Woerden (NL). SHEFFORD, Roger, Alan [GB/NL]; De Hooghkamer 39, NL-2253 JV Voorschoten (NL).

(74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).

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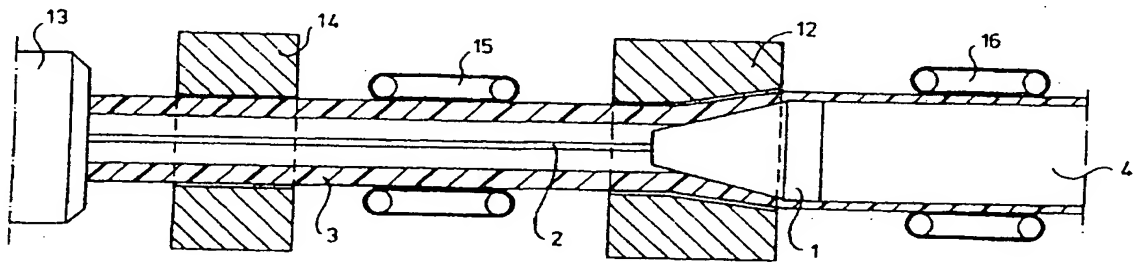
(54) Title: CONTAINER OF STRETCHED PLASTIC MATERIAL, AND PROCESS FOR MAKING SUCH CONTAINER



(57) Abstract

A container comprises a tubular container body (5) at the upper and lower ends of which end pieces (6) are connected. At least said container body comprises stretched plastic material. Also, at least one of the end pieces (6) may comprise stretched plastic material. A process for making the container comprising the steps of: extruding a tube (3) through an annular die (13); stretching the tube (3) in its axial and/or circumferential direction; cutting the tube in lengths so as to obtain a container body (5); connecting an end piece (6) to at least one end of each container body.

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Container of stretched plastic material, and process for making such container

The invention is related to the field of containers, for instance semi bulk drums or containers e.g. in the range of 15 to 300 litres. Such drums can be made of various materials, such as metal, glass or plastics. Plastics have many advantages over competing materials, for example low weight, transparency or translucency for viewing the contents; they are suitable for packaging a wide range of products. Moreover, plastics offer a much greater degree of freedom in shaping the container which leads to more attractive designs and more convenience for the consumer.

Plastics materials are very ductile, which means that the risk of accidental breakage is decreased and the security of the contents is increased. Minor denting of the drum recovers immediately, unlike metal containers.

Plastics however have the disadvantage of a relatively low rigidity. This means that the wall thickness of a plastic container or drum is always much greater than the wall thickness of an equivalent metal one. This increases the cost of a plastic container, not only due to the greater amount of raw material required but also due to the energy which is necessary for the conversion thereof.

Moreover, the size of such container is increased which leads to a reduction of the number of containers which can be transported or stored in a given vehicle or space. As a result the overall cost of packaging is increased, and also the environmental impact.

These problems are furthermore of particular importance with respect to the stacking capability of the drums. For instance, 200 litre steel drums can be stacked up to 5 metres high. Equivalent drums from high density polyethylene can be stacked up to 3 metres high in spite of a three times greater wall thickness.

Finally, many plastics absorb liquids and vapours, which reduces their strength further. For example, HDPE will absorb hydrocarbon solvents.

The object of the invention is to provide a container with an increased rigidity, strength and impact resistance. Thereby a greater stackability or a lower weight could be obtained, which could make the plastic drums more equivalent to their steel counterparts.

Also a reduced absorption by the drum wall of components of the contents of the drum (such as hydrocarbons) is desired, to prevent a further reduction of the useful properties of the drum. Moreover, there should be a reduced permeability of the wall of the drum to gases as well as components of the contents of the drum. These objects are achieved in that at least the container body comprises stretched plastic material.

The stretched material of the container body has a higher stiffness and strength than the corresponding non-stretched material. Thereby, the resistance of the container body against external loads and buckling is increased appreciably, resulting in better stackability.

Also, the end pieces may consist of stretched material.

Preferably, the plastic is stretched into two mutually perpendicular directions; for instance, the container body may consist of a length of biaxially stretched tubular material.

The invention is also related to manufacturing of an improved container. According to a first possibility, such process comprises the steps of:

-extruding a tube through an annular die;

-stretching the tube in its axial and/or circumferential direction;

-cutting the tube in lengths so as to obtain a container body;

-connecting an end piece to at least one end of each container body.

Making containers from a continuously extruded tube with moulded ends per se is known from GB-A-1535287. Furthermore, various methods have been tried of improving the rigidity of the extruded tube. As an example, a closed cell foam has been used for the container walls. Thereby the stiffness for a given weight is increased, but the wall thickness needs to be greater. Also, the impact strength is reduced considerably.

Furthermore, combinations of ribs and corrugations have been used, but their effects appeared to be only marginal.

By means of the process according to the invention, a container is obtained which has a thin-walled body with an excellent rigidity and strength. Both features are obtained by biaxially stretching the tube from which the body is made.

Manufacturing a bottle from an extruded stretched tube, by cutting said tube in appropriate lengths per se is known from EP-A-52490. This known process is however not suitable for manufacturing containers such as drums. In said known process, first of all a length is cut from a piece of tubular material, and subsequently said length is stretched. The disadvantage here is that such process is not continuous but takes place in a batch-wise manner. Thereby, end-effects are generated in the lengths of tubular material, which makes this batch-wise process difficult to control.

In particular in processing larger diameter tubes, continuous stretching of the tubular material is preferred; it offers a faster process with a uniform quality and reduced failure rate.

Good results are obtained in case the container body is stretched up to 4 times in the radial direction, and the container body is stretched 2-10 times in the axial direction.

Although the process described before is related to extruding a tube, the invention is not limited to such manufacturing method. For instance, according to a second possibility, the process could also comprise the following steps:

- stretching a plate of plastic material,
- connecting two opposing edges of the stretched plate so as to form a tubular body,
- connecting an end piece to at least one end of the tubular body.

The processes for connecting the end(s) according to the invention can be carried out in various ways. It may comprise the steps of:

-heating the surfaces of each end piece and the corresponding container body end by a heating device until the material of said surfaces is molten;

-removing the heating device;

-pressing each end piece and the container body against one another until the material has solidified.

Alternatively, the process for connecting the end(s) to the tube according to the invention may comprise the steps of:

-forcing at least one end of the container body over a conically shaped mandrel so as to form a conically shaped weldable surface;

-providing an end piece for each container body end having a correspondingly, conically shaped weldable surface;

-melting the material of the weldable surfaces;

-pressing each end piece into and against the conically shaped end of the container body until the material has solidified.

Welding the ends to the container body is also possible in several ways, for instance by means of an ultrasonic device, by an infra-red device, or by a vibration device.

The end piece may also be connected to the container body by means of glueing.

For manufacturing a drum with a barrel-shape, the process may additionally comprise the step of heating the container body at least one of its ends for shrinking the plastic material so as to form an end with a converging shape.

Furthermore, it is observed that in the process of manufacturing a container from an extruded tube, proper control mechanisms should be applied for cooling the inside and the outside of the extruded tube, so as to obtain a regular stress distribution over the wall thickness. This can for instance be done according to the process described in EP-A-209933. A uniform temperature distribution is necessary in order to enable the stretching process to be carried out in a proper way.

The invention will be explained further with reference to the figures, related to only one of the possible embodiments and methods of manufacturing.

Figure 1 shows a schematic view of biaxially stretching a tube.

Figure 2a and b show a first method of welding an end plate to a drum body by means of a hot plate.

Figure 3 shows a second method for welding an end plate to a drum body.

A tube of stretchable thermoplastic material such as high density polyethylene (HDPE) is extruded through an annular die 13 and is pulled through a cooling bath 14 by a pulling device 15 such as a set of caterpillars which are situated at regular internals around the tubes. It is subsequently reheated by a reheater 12 and pulled over a mandrel 1. The cooling and heating sections have to be adjusted so that the HDPE is in the temperature range of 100°C-130°C when it is pulled over the mandrel. The mandrel is held in place by means of a pulling rod 2, which is fixed to the extrusion die 13.

The tube 4 is pulled over the mandrel 1 by means of pulling device 16 which may also be a set of caterpillars which are situated at regular intervals around the tube. In this pulling process the tube is stretched in the axial direction. Radial stretching also occurs as the tube 3 is pulled over the mandrel 1.

By changing the cross sectional shape of the mandrel (e.g. square or rectangular) a similarly shaped tube can be made.

The biaxially stretched tube 4 thus obtained is cut into pieces of appropriate size 5 by cutting means (not shown).

The pieces 5 thus obtained are to form the drum body of a drum. Figures 2a and 2b show a drum body 5 in question, at one end of which an end piece 6 is situated. By means of a hot plate 7, the facing surfaces of drum body 5 and end piece 6 are heated, such that they can be fused together by pressing them onto each other.

In the embodiment of figures 3a and 3b the end of the drum body 5 is forced over a conical heating ring 8, whereby both a conical end section 9 is obtained, and the inner surface of this end section 9 is molten. Furthermore, the end moulding 10, in particular the outer surface 11 thereof, is heated by means of a heating ring 12 until said surface 11 melts.

Subsequently, heating rings 8 and 12 are removed, and the end moulding 10 is pressed into the conically widened end section 9 of drum body 5. Thereby, a solid bond as shown in figure 3b is obtained.

Although in the embodiments described the end pieces are welded to the container body, other methods may be applied as well, such as glueing.

Claims

1. Container, comprising a tubular container body at the upper and lower ends of which end pieces are connected, characterized in that at least the container body comprises stretched plastic material.

2. Container according to claim 1, wherein at least one of the end pieces comprises stretched plastic material.

3. Container according to claim 1 or 2, wherein the plastic material is stretched into two mutually perpendicular directions.

4. Container according to claim 3, wherein the container body is stretched up to 4 times in the radial direction.

5. Container according to claim 3 or 4, wherein the container body is stretched 2-10 times in the axial direction.

6. Container according to claim 1, 2, 3, 4, or 5, wherein the container body consists of a length of biaxially stretched, tubular material.

7. Container to claims 1 to 6, wherein one or both of the ends are of a different colour to the body.

8. Container according to claims 1 to 6, wherein one or both of the ends are of a different material to the body.

9. Process for making a container according to any of claims 1-8 comprising the steps of:

-extruding a tube through an annular die;

-stretching the tube in its axial and/or circumferential direction;

-cutting the tube in lengths so as to obtain a container body;

-connecting an end piece to at least one end of each container body.

10. Process according to claim 9, whereby the tube is cooled as it is extruded and reheated to the correct temperature before stretching.

11. Process according claim 10, whereby the cooling is applied to both the inside as well as the outside of the tube.

12. Process for making a container according to any of claims 1-8, comprising the steps of:

- stretching a plate of plastic material,
- connecting two opposing edges of the stretched plate so as to form a tubular body,
- connecting an end piece to at least one end of the tubular body.

13. Process according to any of claims 9-12, whereby an end piece is connected to both ends of the container body.

14. Process according to any of claims 9-14 comprising the steps of:

-heating the surfaces of each end piece and the corresponding container body end by a heating device until the material of said surfaces is molten;

-removing the heating device;

-pressing each end piece and the container body against one another until the material has solidified.

15. Process according to any of the claims 9-14, comprising the steps of:

-forcing at least on end of the container body over a conically shaped mandrel so as to form a conically shaped weldable surface;

-providing an end piece for each container body end having a correspondingly, conically shaped weldable surface;

-melting the material of the welding surfaces;

-pressing each end piece into and against the conically shaped end of the container body until the material has solidified.

16. Process according to claim 14 or 15, whereby each end is welded to the container body by means of a hot plate.

17. Process according to claim 14 or 15, whereby each end is welded to the container body by means of an ultrasonic device.

18. Process according to claim 14 or 15, whereby each end is welded to the container body by an infra-red device.

19. Process according to claim 14 or 15, whereby each end is welded to the container body by means of a vibration device.

20. Process according to any of claims 9-12, whereby each end piece is connected to the container body by glueing.

21. Process according to any of claims 9-20, comprising the step of heating the container body at at least one of its ends for shrinking the plastic material so as to form an end with a converging shape.

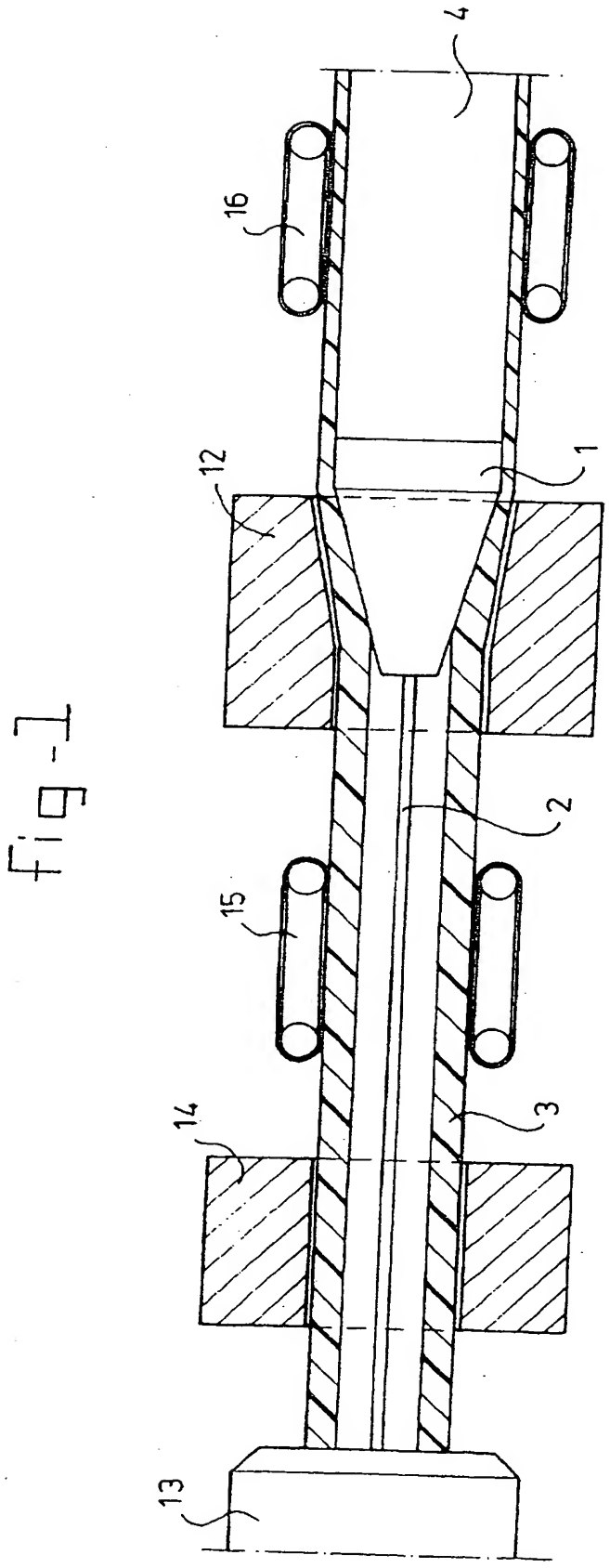


Fig-1

Fig-2a

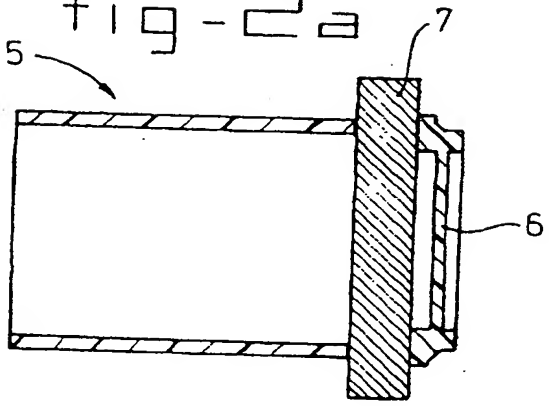


Fig-2b

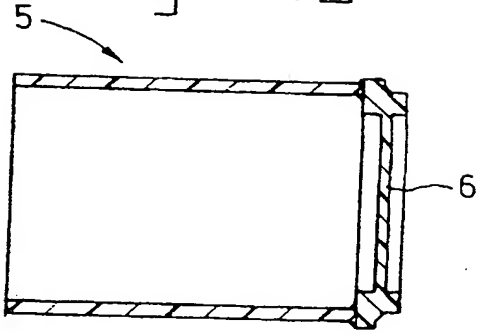


Fig-3a

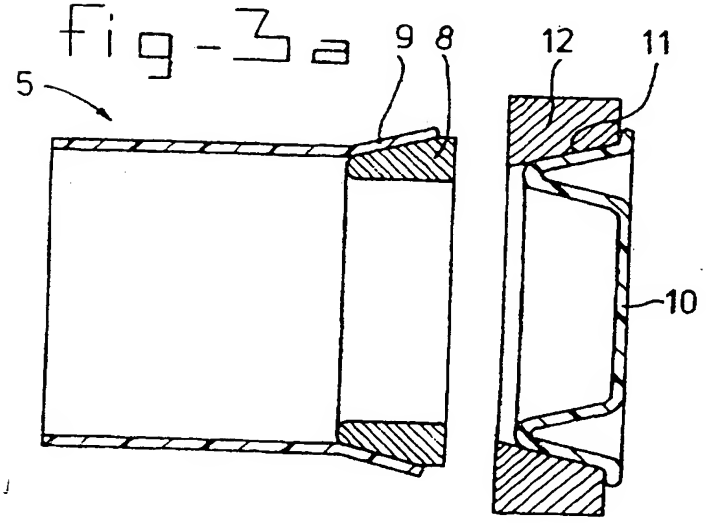
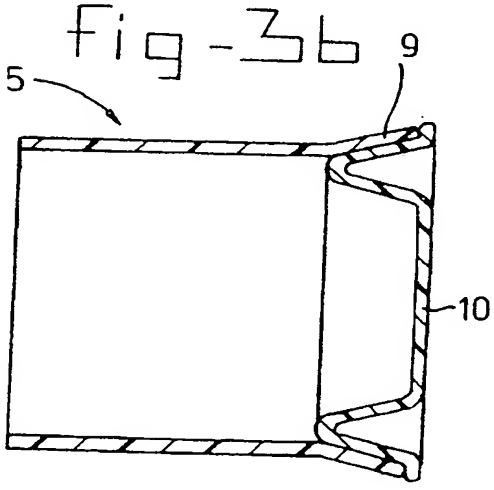


Fig-3b



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A. CLASSIFICATION OF SUBJECT MATTER
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 447 199 A (REED LEONARD W ET AL) 8 May 1984 cited in the application see column 3, line 60 - column 6, line 56; claim 14; figures 1-6	1-11
X	US 4 809 876 A (TOMASWICK KATHLEEN M ET AL) 7 March 1989 see column 3, line 29 - line 65; figures	1-8
X	GB 2 156 268 A (VERCON INC) 9 October 1985 see page 2, line 31 - line 38 see page 4, line 5 - line 65; figures 4-6,14-17	1-8, 12-21

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 649 962 A (VINOKUR ISAAC) 17 March 1987 see abstract see column 3, line 42 - column 4, line 9; figures	1,12
A	US 3 967 991 A (SHIMANO IKUYA ET AL) 6 July 1976 see column 4, line 9 - line 18 see column 7, line 26 - column 8, line 58; figures 5-7	12-21
A	WO 95 25628 A (WAVIN BV ;PRENGER JAN HENDRIK (NL); SCHUURMAN JOHAN (NL); VISSCHER) 28 September 1995 see abstract; figure	9-11
A	EP 0 371 769 A (NAT RES DEV) 6 June 1990 see page 5, line 1 - line 7; figure	9-11
A	EP 0 689 926 A (RHONE POULENC FILMS) 3 January 1996 see abstract see page 4, line 35 - line 54	2

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ...onal Application No
PCT/NL 96/00345

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4447199 A	08-05-84	GB 2089276 A	23-06-82
		AU 559758 B	19-03-87
		AU 3350884 A	17-01-85
		AU 540844 B	06-12-84
		AU 7744981 A	27-05-82
		CA 1170806 A	17-07-84
		CA 1211390 C	16-09-86
		EP 0052490 A	26-05-82
		EP 0150866 A	07-08-85
		JP 1590687 C	30-11-90
		JP 2014886 B	10-04-90
		JP 57115324 A	17-07-82
		KE 3524 A	24-05-85
		US 4547416 A	15-10-85
		US 4735538 A	05-04-88
US 4809876 A	07-03-89	NONE	
GB 2156268 A	09-10-85	AU 3866985 A	03-10-85
		BE 902021 A	26-09-85
		DE 3510956 A	07-11-85
		FR 2561575 A	27-09-85
		GB 2156265 A	09-10-85
		JP 60224533 A	08-11-85
		SE 8501423 A	27-09-85
		AU 4099185 A	24-10-85
		JP 60232940 A	19-11-85
US 4649962 A	17-03-87	AU 577124 B	15-09-88
		AU 4397785 A	02-01-86
		BR 8503035 A	11-03-86
		CA 1245096 A	22-11-88
		EP 0166226 A	02-01-86
		JP 1876912 C	07-10-94
		JP 6000379 B	05-01-94
		JP 61083024 A	26-04-86
US 3967991 A	06-07-76	JP 975063 C	19-10-79
		JP 50063077 A	29-05-75
		JP 53004556 B	18-02-78

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/NL 96/00345

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3967991 A		JP 945703 C	30-03-79
		JP 49081480 A	06-08-74
		JP 52038593 B	29-09-77
		AU 452152 B	29-08-74
		AU 6323873 A	29-08-74
		CA 1041261 A	31-10-78
		CH 573300 A	15-03-76
		DE 2361038 A	27-06-74
		FR 2209657 A	05-07-74
		GB 1435217 A	12-05-76
		NL 7316710 A,B,	11-06-74
WO 9525628 A	28-09-95	NL 9400452 A	01-11-95
		AU 1962195 A	09-10-95
		CA 2185701 A	28-09-95
		EP 0751862 A	08-01-97
		FI 963738 A	20-09-96
		PL 316237 A	06-01-97
EP 0371769 A	06-06-90	AT 128667 T	15-10-95
		AU 636586 B	06-05-93
		AU 4561489 A	07-06-90
		CA 2004103 A	31-05-90
		DE 68924467 D	09-11-95
		DE 68924467 T	09-05-96
		GB 2225551 A,B	06-06-90
		JP 2258323 A	19-10-90
EP 0689926 A	03-01-96	FR 2721935 A	05-01-96
		BR 9502952 A	12-03-96
		CA 2153088 A	02-01-96
		CN 1133226 A	16-10-96
		CZ 9501721 A	17-01-96
		FI 953254 A	02-01-96
		HU 73290 A	29-07-96
		NO 952630 A	02-01-96
		PL 309419 A	08-01-96
		SK 85195 A	10-01-96
		ZA 9504880 A	31-01-96